A decade ago, ICOM revolutionized ham radio with its mobile HF/VHF/UHF multimode IC-706. How does the company's "next generation" IC-7000 stack up? AD5X put the rig to the test, including a head-to-head comparison with the classic 706 and the ultra-portable IC-703. Here's his report:

CQ Reviews:

The ICOM IC-7000 Transceiver

BY PHIL SALAS,* AD5X

Like many of you, I've been following the introduction of the ICOM IC-7000 over the past year. I've owned an IC-706MKIIG since 1999, and it has served me extremely well both in mobile and portable applications. I have also owned an IC-703 for nearly two years and have been well pleased with this transceiver as well.

Thus, when *CQ* asked me if I'd be interested in reviewing the IC-7000, I jumped at the chance, not only so I could evaluate this new transceiver, but also so I could answer two questions: (1) How does the receiver of the IC-7000 compare to the receivers of the IC-706MKIIG and the IC-703 under the same band conditions? (2) Is it time for me to upgrade my IC-706MKIIG to an IC-7000?

Photo 1– ICOM's new IC-7000 has more features per cubic inch than any other compact transceiver on the market. (Photo courtesy of ICOM America)

First Look

Right out of the box you can see the more modern, 21st-century look of the IC-7000 (see photo 1). When compared to the IC-703 and IC-706MKIIG, the IC-7000 has more subtly rounded corners, and flat panel buttons as opposed to the more familiar protruding buttons of the earlier transceivers. Also, the size of the IC-7000 main tuning knob has been increased slightly. Along with the tuning-dial diameter increase, ICOM increased the number of buttons on the front panel from 14 to 17, yet the front panel looks less cluttered than that of the IC-706MKIIG or IC-703. When I began setting up the three radios so I could begin my evaluation, I also saw that the IC-7000 is 1/2 inch shorter than the other radios (9 inches overall length including knobs and heat sink) as you can see in photo 2.

However, the really attention-grabbing physical feature of the IC-7000 is the incredible color display—and man oh man, what a display! While the display is just 2.5 inches diagonally, it provides a *huge* amount of information. It is really something to be able to meter power output, ALC, compression, and SWR along with frequency, S-meter, and heat-sink temperature all at the same time! Photo 3 shows how ICOM's use of text, figures, and colors makes all the information easy to see. Also, for mobile operation, photo 4 shows the large text-font mode you can select to make it even easier to read the basic frequency information. You can select a black, white, or blue background. My preference is the default black background. Unfortunately, my photos don't do justice to the display. You need to see this in person!

To make things even better, the IC-7000 has a composite video output for driving an external video monitor. This is really nice for home station use. Photo 5 shows the normal fonts on an external LCD 13-inch monitor. Expanded fonts with a bigger display are also available.

I had heard complaints that the external display output did not look all that good. If that was the case in early IC-7000 transceivers, it is certainly not the case now. I think that the external display quality is excellent.

First, A Few Basic Tests

While the numbers game has been done in other publications, I did want to make a few measurements prior to actually starting operational and on-the-air evaluations. I focused on 160–6 meters, as I am primarily an HF operator. For details of the IC-7000 operation in the VHF/UHF bands, refer to the excellent review by Steve Hicks, N5AC, in the Winter 2006 issue of *CQ VHF* magazine. My test setup is shown in photo 6, and a close-up of the three transceivers is shown in photo 7.

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First I measured the typical current requirements of the IC-7000. The receiver current drain, spec'd at 1.6 amps max at normal volume, measured just 1.3 amps at normal volume. The transmitter current measurements at 100 watts output into an MFJ-267 wattmeter/dummy load (160–6 meters) are displayed in Table I (spec is 22 amps maximum).

The transmit power can be varied continuously from 2–100 watts from 160–6 meters. For those of us who may also be interested in using this radio for QRP and/or HF Pack operation, I measured IC-7000 transmit current requirements at 5.3 amps at 2 watts output and 5.8 amps at 5 watts output.

Next I checked the SWR point where the IC-7000 starts turning down power (SWR protection). I did this by putting an external Diamond SX-1000 SWR meter in series with an MFJ-902 antenna tuner and the dummy load/wattmeter. I tuned the MFJ-902 for a 1:1 match into the dummy load, and then varied the tuner's inductor and capacitors as necessary until I could just barely see the output power decrease. Then I measured the SWR into the detuned antenna tuner. I found that between 160 and 6 meters, the IC-7000 would consistently begin turning down power at an SWR between 2:1 and 2.5:1.

Finally, I checked the receiver sensitivity at S9 and S-meter tracking from S-9 to S-1 (dB below S-9). The results are shown in Table II and are pretty good! Tracking is about 5–6 dB/S-unit (the "standard" is 6 dB/S-unit), and the S-9 meter reading is at or close to the "standard" of 50 µV. My test equipment consisted of a Tektronix 191 RF generator, a Hitachi V-355 oscilloscope, and a pair of MFJ-762 step attenuators. While there is a certain amount of inaccuracy due to the coarse bar-graph display on the IC-7000, I switched in attenuation just above and just below the desired reading to center my measurements and make them fairly accurate.

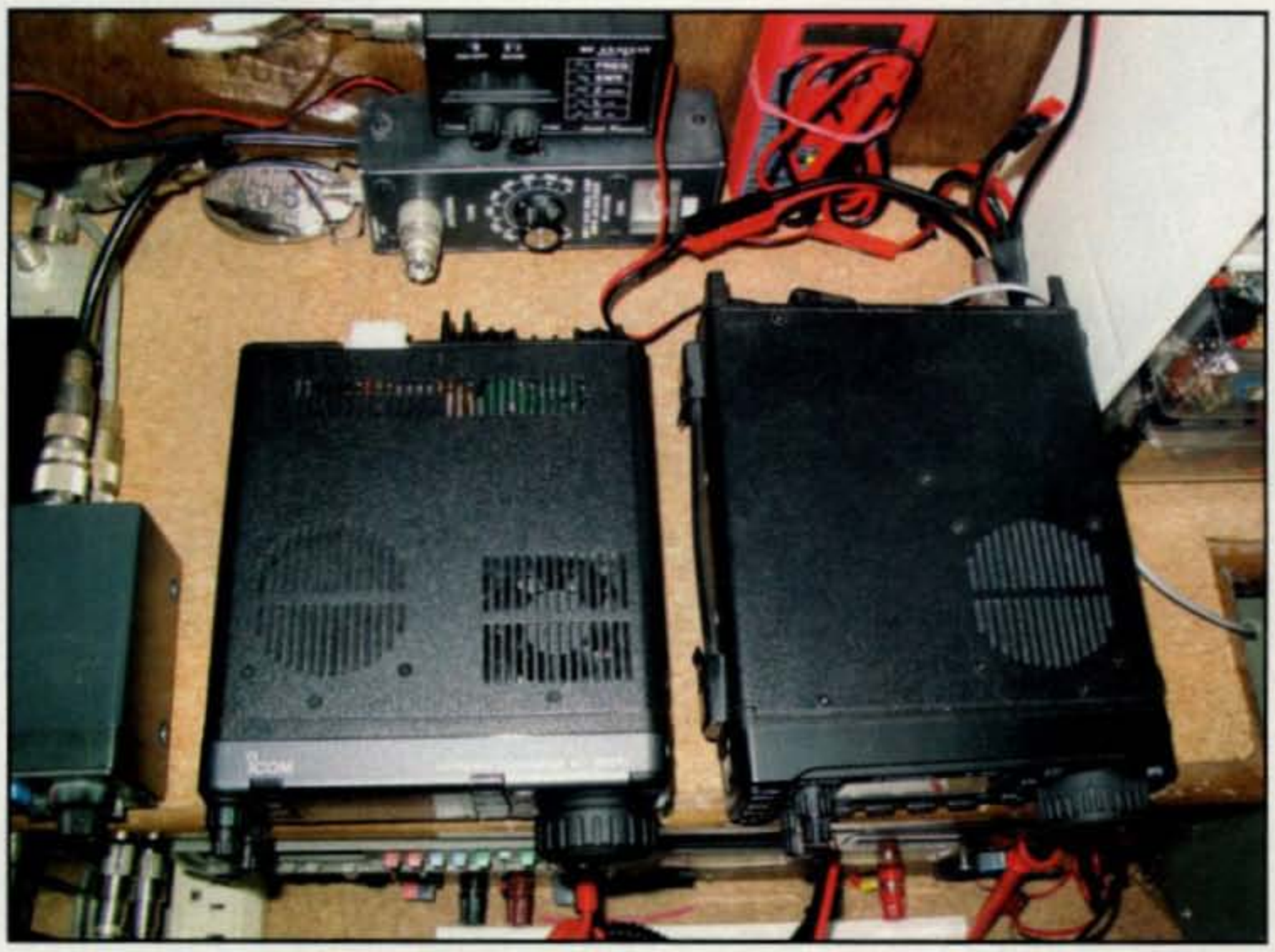

Photo 2– The IC-7000 is on the left (notice the fan), and the longer IC-703 is on the right!

Using the IC-7000

Right out of the box, you can just plug in your microphone, dial in your operating frequency, and start operating SSB. Since many functions have their own front-panel buttons (such as noise blanker, noise reduction, and manual and automatic notch filtering), you don't have to go into menus to enable them. However, if you want to operate other modes, you need to read the manual. And if you want to get all you can out of this transceiver, you *definitely* need to read the manual. If you have an IC-706MKIIG or an IC-703, you'll find many similarities in the IC-7000 menu system. However, there are still plenty of differences, since so many more features have been added to the IC-7000.

First of all, since the IC-7000 is all DSP-based, you'll find that all the filtering you will ever need is built-in. There are three default filter widths per mode, and two filter shape factors for each SSB and CW filter width. These filter characteristics are easily changed if you don't like the defaults. The IC-7000 has a 4-bank memory keyer and a voice recorder that can play back pre-recorded messages on the air or record signals coming in over the air. It also has a transmit monitor so you can hear how you sound, and then, of course, you have speech processing, split operation, band-stacking registers, direct frequency entry with the microphone, etc., etc. Read the manual to at least get a feel for where to look for information when you need it.

In my case, I started out on CW, since that is my preferred mode of operation.

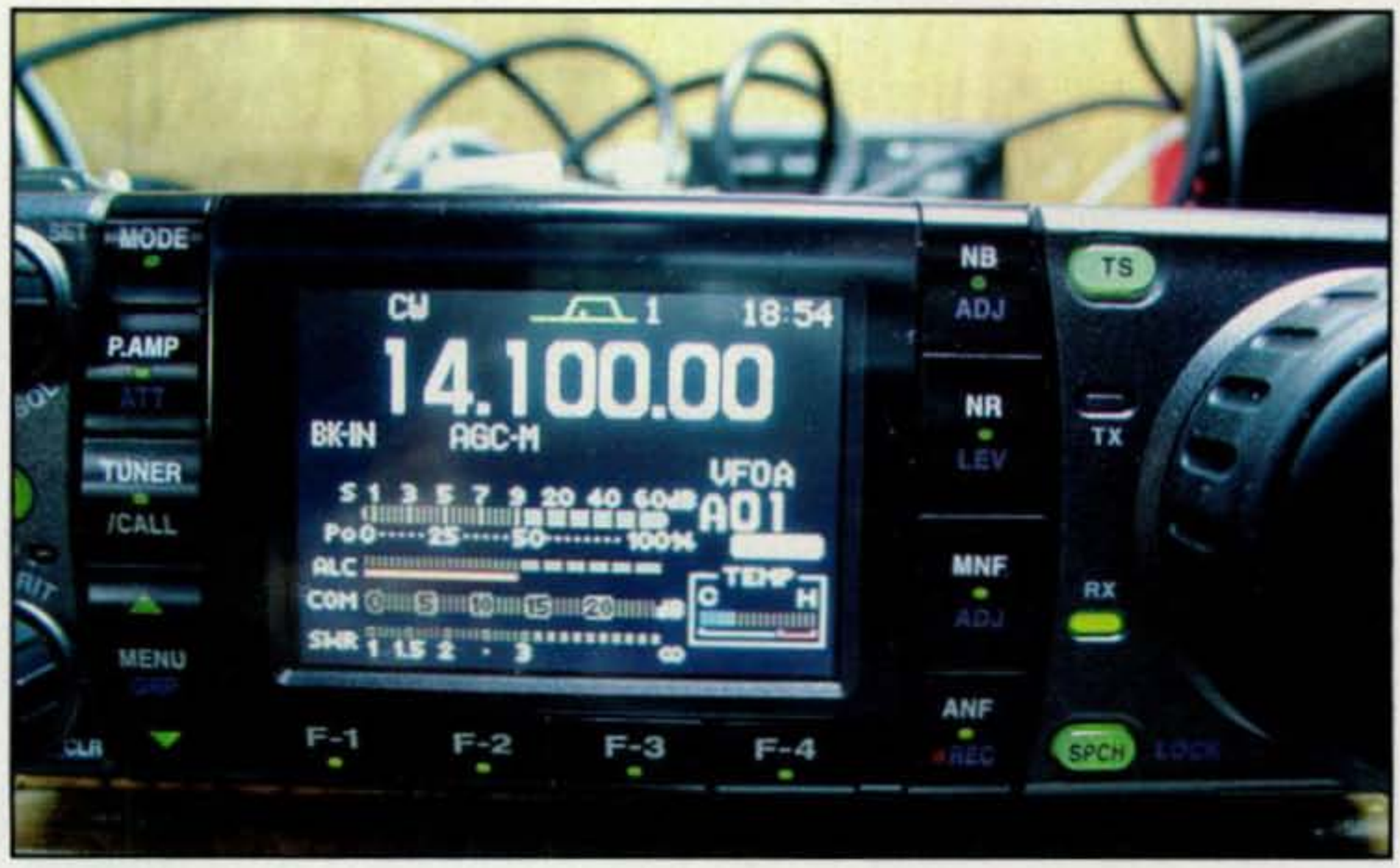

Photo 3– A tremendous amount of information can be displayed with the normal font.

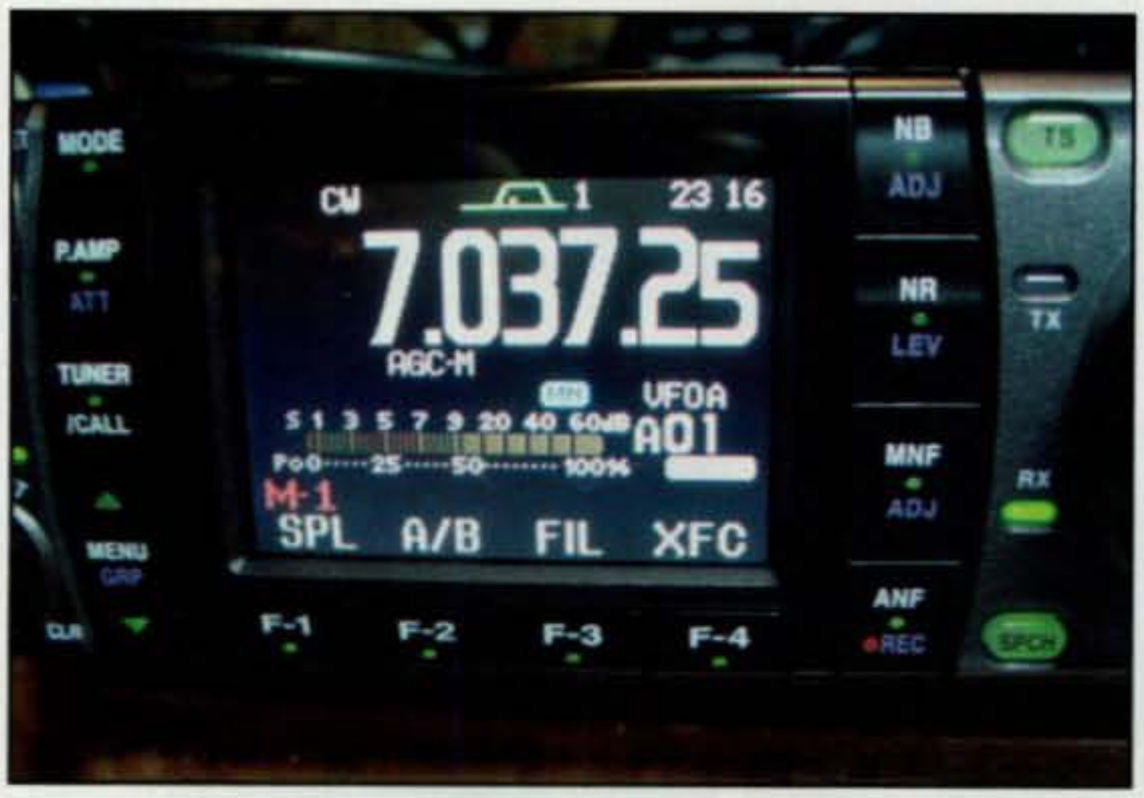

Photo 4– Expanded font for frequency is nice for mobile operation.

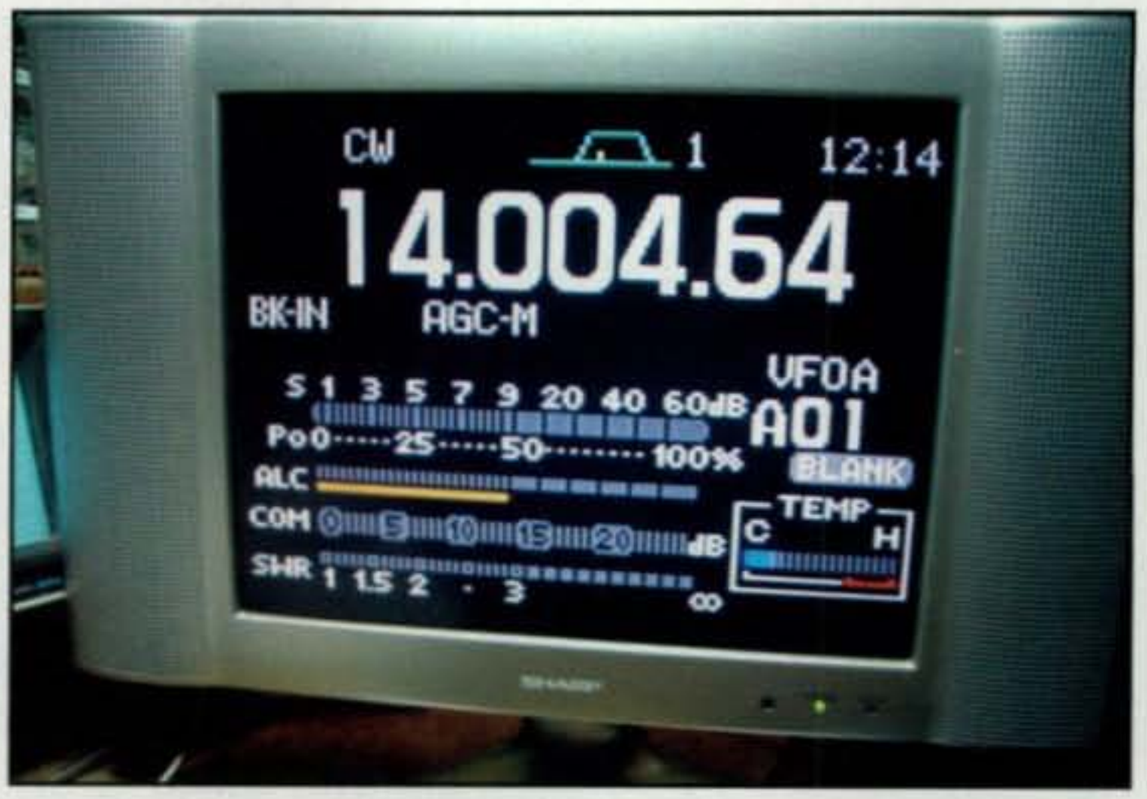

Photo 5– Normal display on remote 13-inch LCD monitor. An expanded font may also be selected.

Without referring to the manual, I was able to turn on break-in, set the break-in time delay, and start operating with a paddle at the default speed of 20 wpm. However, I had to refer to the manual to change the keyer speed—which is not quite as convenient as on the IC-706MKIIG/IC-703. On the earlier radios you push and hold the DISPLAY key for about a half-second. Assuming that CW speed is selected, you change the speed with the main tuning dial and then tap the DISPLAY button to return you to the previous menu/display setting. With the IC-7000, you first have to tap the AF SET button to get into "set mode," then punch QS for the Quick-Set menu. Assuming that CW speed is selected, change the CW speed with the main tuning dial and then push the MENU/GRP key twice to return you to your selected display. In the earlier radios, changing CW speed required two presses of the same key to get in and out of the speed-setting screen. For the IC-7000, you require four presses of three different keys to get in and out of the speed-setting screen. After a little practice, though, I was able to do this without giving it much thought.

Something ICOM does really well is base the CW break-in time on a fixed number of dits. This is great, since the break-in time changes proportionally with changes in CW speed. I've always really liked this feature. I normally operate semi-break-in unless I'm trying to nail that DX station in a pile-up. Then I switch to full break-in.

The default filters for CW are 1200 Hz, 500 Hz, and 250 Hz. I think these are perfect, but they all are changeable if you prefer different filter widths. Just a tap on the FIL soft-key in Menu M3 cycles through the three filters. When I

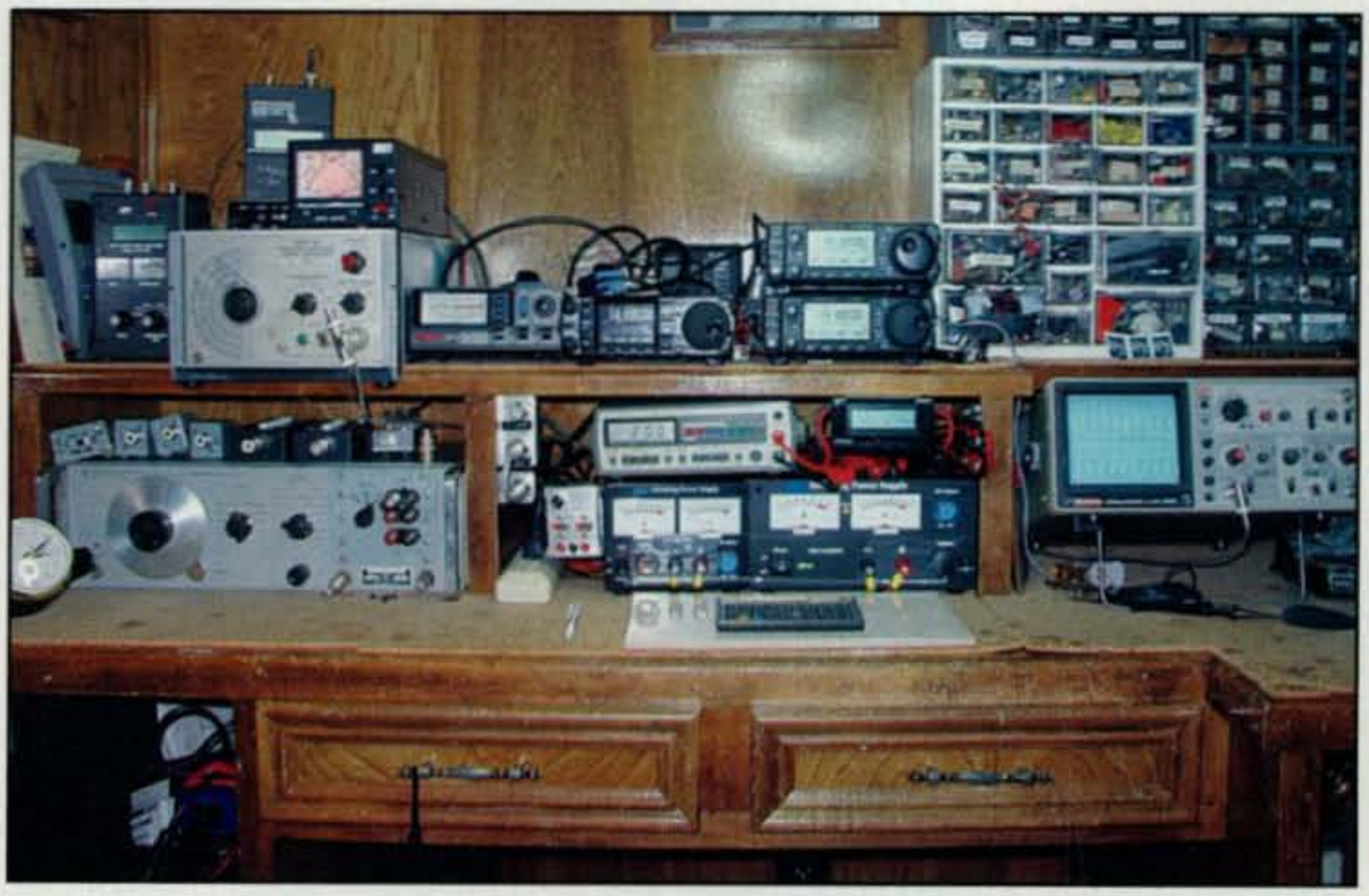

Photo 6– The author's test setup.

really need to dig out a weak signal, I leave the 250-Hz bandwidth alone, but then turn on the two manual notch filters and set them just above and below the desired signal as displayed in photo 8. This really makes the signal seem to pop out of the noise floor!

CW operation was smooth and easy, using either semi- or full break-in. I normally operate by first turning off break-

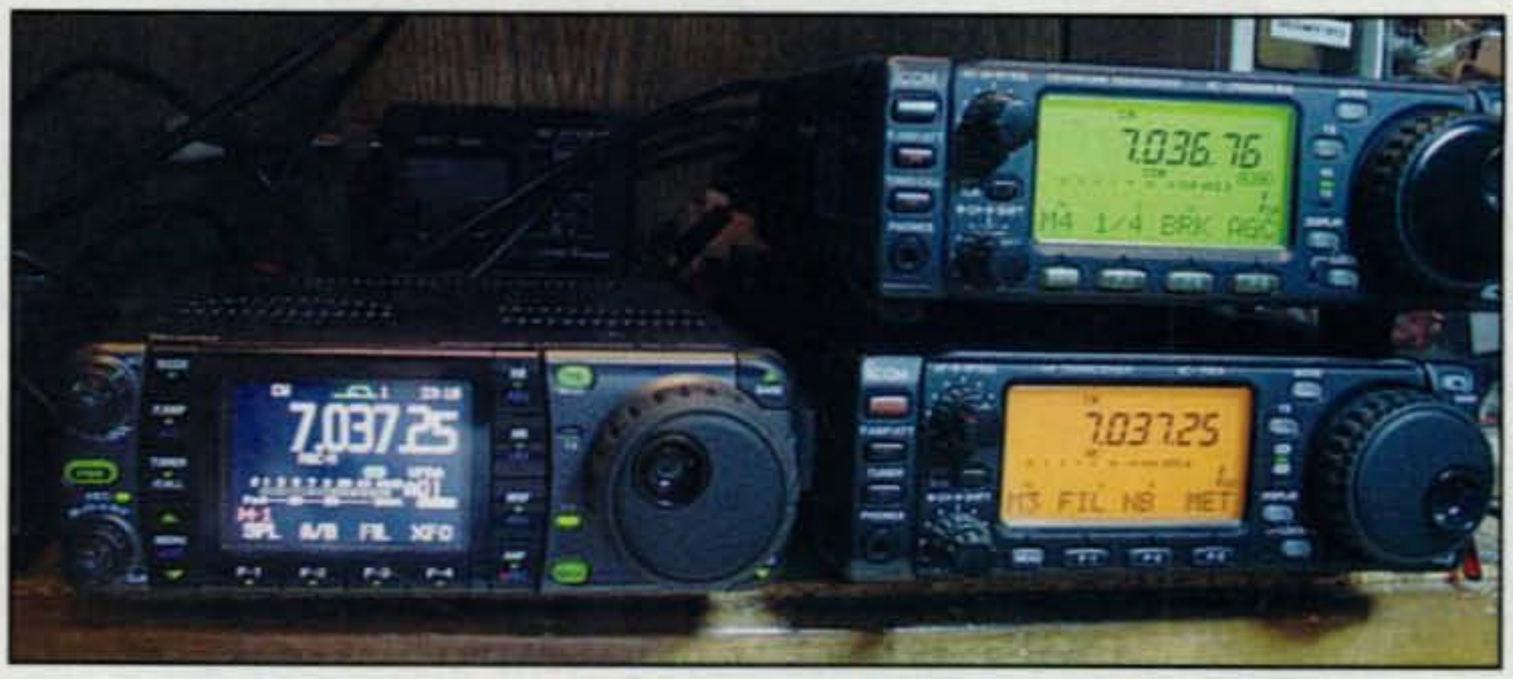

Photo 7– Close-up of the IC-7000, IC-706MKIIG, and IC-703

160m	80m	40m	30m	20m	17m	15m	12m	10m	6m
18.4A	16.8A	19.7A	16.2A	19.6A	19.3A	17.0A	20.0A	18.6A	19.5A

Table I– Transmitter current requirements at 100 watts output power.

in to zero-beat a station with a string of dits. As part of this operation, it is easy to determine if my keying speed needs to be changed. Then I turn on break-in, select a filter based on band conditions, and transmit.

Next I went to SSB. The first thing you'll notice is that the IC-7000 microphone is a little more imposing than the mics of the earlier IC-706MKIIG/703 radios, although it really is not that much larger. The more imposing IC-7000 mic is a result of all the extra things you can do with it, such as direct frequency entry, band stacking registers, filter selection, and many of the things that are normally done through the display menus. A good-size comparison of the microphones is shown in photo 9.

I first checked the mic gain by looking at ALC, and then compression level. Both were perfect for my voice. When transmitting into my peak-reading wattmeter/dummy load, I really couldn't see any difference with the compressor on or off, since the peak power stays the same. However, when I set the power meter to read normal power, I could see a big difference. With the compressor off, normal talking caused the meter needle to hover around the 10-watt mark. When I turned on the compressor, the needle hovered around the 20-watt mark. I verified this with both the MFJ-267 and a Diamond SX-1000 power meter, so it would appear that the compressor doubles your average power.

On-the-air reports were excellent. I was told that the audio "sounds great," or "has good fidelity," or "sounds natural." When I ran tests with and without the compressor, I was told by some folks that my signal level increased by up to an S-unit. Others told me they didn't see any S-meter change, but my voice was more "punchy" and easier to understand.

On SSB the three default receive filters are 3000 Hz, 2400 Hz, and 1800 Hz. I normally operated with the 2400-Hz filter, but there were several times when the 1800-Hz filter really helped – often during crowded 40-meter band conditions, and once on 6 meters when there was a great opening and the band was wall-to-wall signals. With the 1800-Hz filter, you do lose some fidelity, but the selectivity improvement often makes a receive signal comfortable to copy under high adjacent-channel QRM conditions. In all cases, the bandwidth and filter shape are extremely easy to change to suit your needs. At any time, you can just press the DEF key to return to the default filter settings.

My last operational testing effort involved using the IC-7000 with my external amplifier. I have an Ameritron ALS-600 amplifier with an ARB-704 amplifier interface unit. I was happy to see that ICOM kept the accessory socket the same as on the IC-706MKIIG. I just plugged the same ARB-704 ICOM interface cable into the IC-7000. Everything worked fine in SSB. The IC-7000 ALC setting on the ALS-600 was the same as on the IC-706MKIIG. The only issue was that when using CW, I would normally shorten or lose my first "dit" during break-in. I never really had

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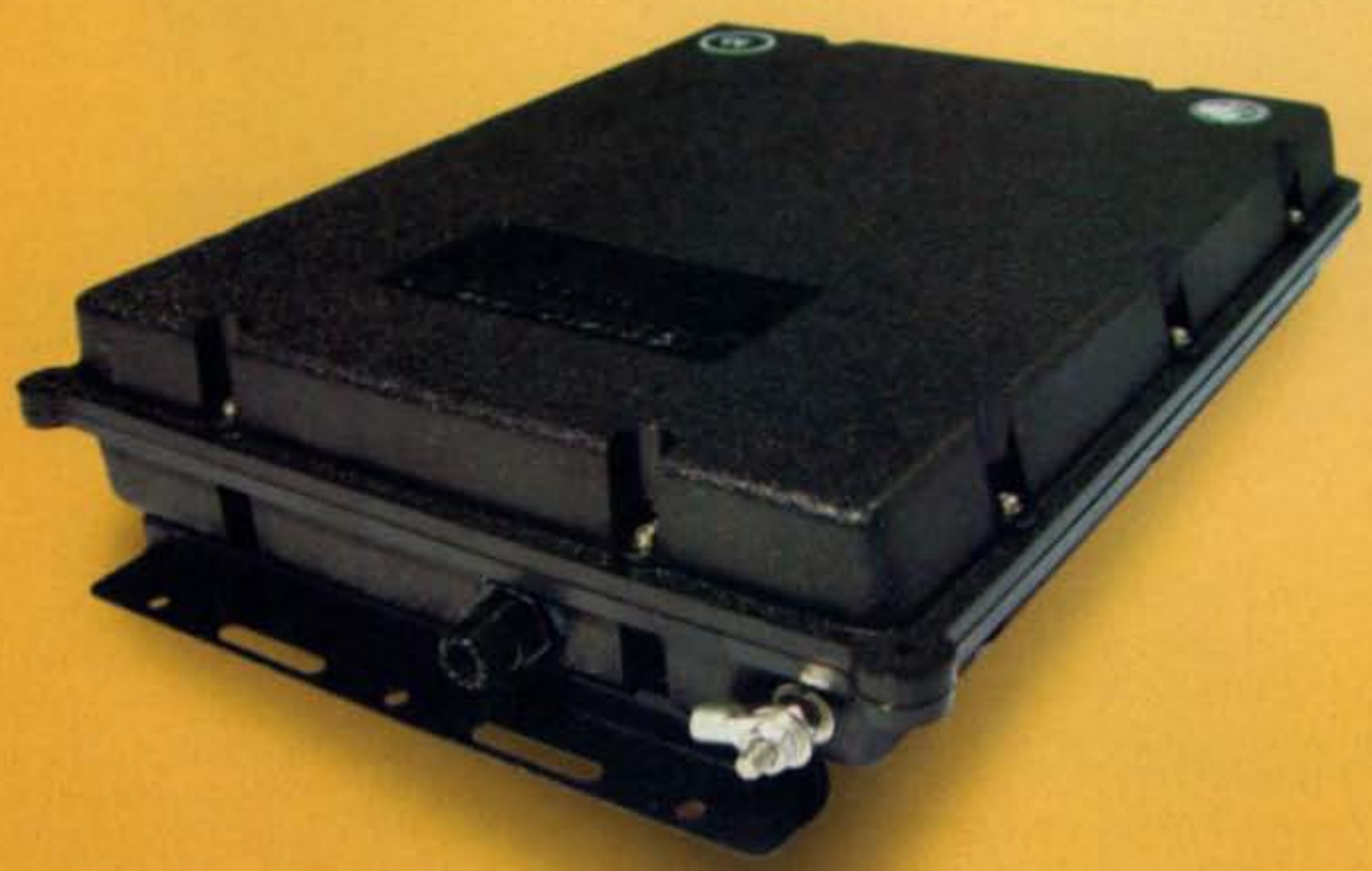

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Band	S-9 level	S7	S5	S3	S1
160m	70 µV	–10 dB	–20 dB	–32 dB	–44 dB
20m	70 µV	–10 dB	–20 dB	–32 dB	–44 dB
6m	50 µV	–10 dB	–20 dB	–32 dB	–44 dB

Table II– S9 receiver sensitivity and S-meter tracking.

this problem with the IC-706MKIIG. Since the HSEND output of the IC-7000 enables the amplifier, I figured that the HSEND-to-RF Output delay must be shorter on the IC-7000 than on the IC-706MKIIG. Thus, I connected my oscilloscope to the RF output and triggered it with the HSEND output. I found that on the IC-706MKIIG, RF output starts at 13 milliseconds after HSEND goes low, and full RF output occurs at 15.5 ms. On the IC-7000, the RF output begins at 8 ms after HSEND goes low, and full output occurs at 11 ms. I measured the ALS-600 relay enable time at 13 ms. Since typical open-frame amplifier relays take 10–20 ms to engage, you may need to use an external foot switch connected to the IC-7000 HSEND input/output to manually enable the IC-7000 transmitter (leave BRK off) when operating CW with a relay-switched external amplifier. I know that this isn't an issue when using an ICOM PW1 amplifier, but in my opinion it is easier to justify the purchase of a PW1 if you have an IC-756PRO3 or IC-7800.

Receiver Comparison Testing

This is the part of my testing that I was really looking forward to—comparing the receivers of the IC-7000, IC-706MKIIG, and IC-703 under real band conditions. The three transceivers were all connected through RF switches so any receiver could be switched on-line at any time. My IC-706MKIIG is equipped with the standard 2.4-kHz SSB filter and both 1.9-kHz and 250-Hz optional filters. My IC-703 is equipped with its standard 2.3-kHz filter and the optional 250-Hz filter. This gave me the opportunity to compare all three radios with their 250-Hz filters and standard wide filters (2.3/2.4 kHz), and the IC-7000 and IC-706MKIIG with their narrow 1.8/1.9-kHz SSB filters. My listening tests spanned several weeks, and I tried to concentrate on times when the bands were crowded (80 and 40 meters after dark and 20 meters in the early evening).

The first thing I observed was that under uncrowded low-noise band conditions I really couldn't tell any difference among the three receivers. All sounded great. However, it was under crowded and noisy conditions that the IC-7000 stood head and shoulders above the other transceivers.

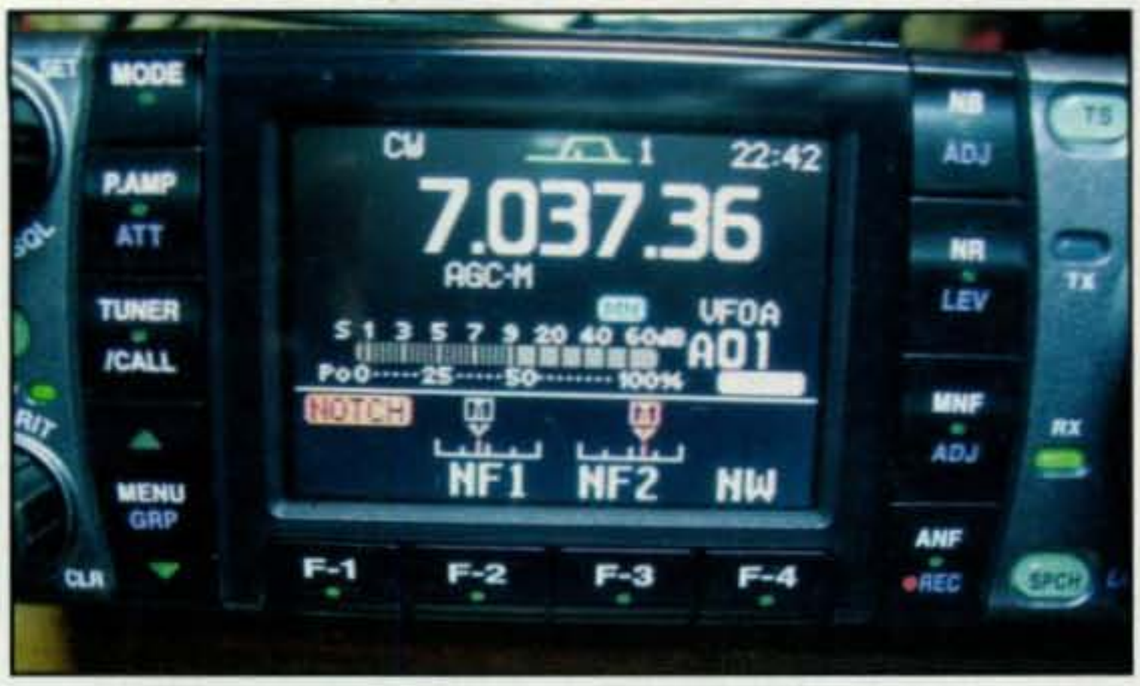

Photo 8– The two manual notches are easy to set. Here NF1 is just below, and NF2 is just above center.

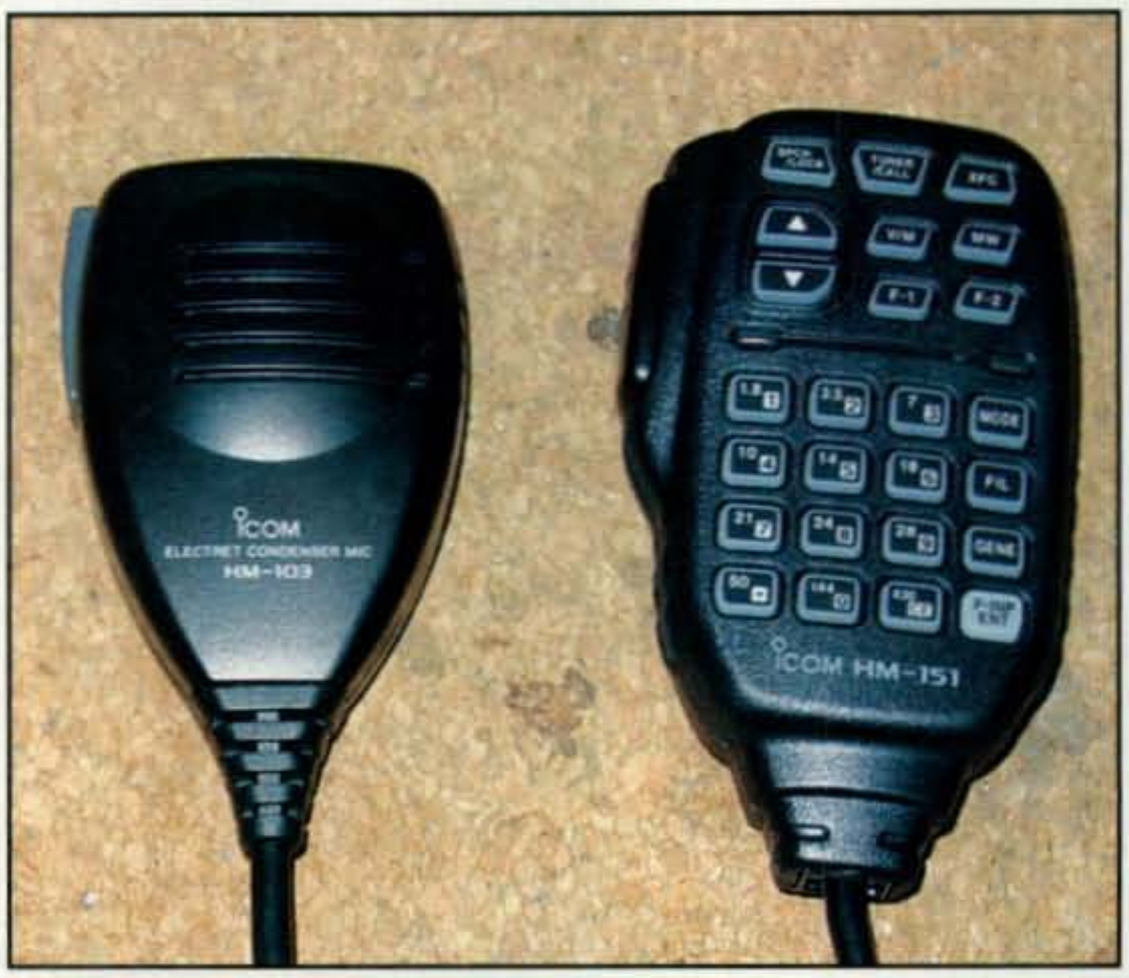

Photo 9– Comparing the IC-706MKIIG mic (left) and the IC-7000 mic (right).

First, the DSP noise reduction in the IC-7000 is significantly better than in the other two radios. I immediately noted far less of a "hollow-echoey" sound on the IC-7000 for the same apparent amount of noise reduction in the three radios. I have a lot of impulse noise at night, and I found that the noise blanker on the IC-7000 did a great job of removing it. The IC-7000 noise blanker actually performs much like the noise blanker on the IC-703, which is much better than that on the IC-706MKIIG. I also had occasional problems with front-end overload on the IC-706MKIIG on 40 meters at night. This problem was never apparent on either the IC-703 or the IC-7000.

It is the IC-7000's IF DSP filtering, though, that really shines. The IF DSP filtering is an integral part of the AGC control loops. Therefore, any interfering signal reduced or removed from the filter pass-band is also removed from the AGC, so there is no pumping of the AGC. I found that the "sharp" settings on the SSB and CW filter shapes are noticeably sharper than any of the corresponding filter shapes on the IC-706MKIIG/703. This was particularly useful when I used the IF-Shift to cut out interference above or below a desired signal. I found the combination of "Sharp" filter setting and IF-Shift particularly useful for SSB operation, where I was frequently able to turn a nasty interfering adjacent-channel SSB signal into a minimally bothersome amount of interference. Then, of course, the filter bandwidths on the IC-7000 are easily adjusted to optimize them for your particular band conditions. I used this feature more on CW, though, as narrowing the SSB filter more than 1.8 kHz really hurt signal readability. However, as I mentioned earlier, I found the twin manual notch filters to be outstanding when used in CW to provide additional filtering in extremely crowded or weak-signal conditions.

All in all, the IC-7000 IF DSP filtering, noise reduction, and noise blanker make the receiver a real performer. These turn difficult copy into comfortable copy—something that is much more difficult or impossible to do on the IC-706MKIIG/703, especially when band conditions are not optimal.

Possible Improvements

This is really quite a radio. However, there are just a few things that I'd like to see changed. I suspect that the changes could

be made with firmware upgrades to the existing product.

For CW operation, I would like to see the commonly used CW functions on the same menu. As an example, putting BRK, 1/4, FIL, and SPEED all on the M3 menu would be very nice. AGC (currently on the M3 menu) can be moved to where FIL was on the M1 menu. These changes would really make the IC-7000 a great CW radio.

Then I'd like to see the HSEND-to-RF Output delay fixed at 20 milliseconds. This would ensure that you would not have any CW break-in issues with virtually any relay-enabled external amplifier.

Finally, the IC-7000 has a speech synthesizer built in, which works very well. I really like hearing the mode-change announced, as well as frequency and S-meter reading when desired. Why not have a menu option that enables the speech synthesizer to read out any menu button push? I think this would be great for mobile operation, helping you keep your eyes on the road. I also have several blind ham friends who like the IC-706MKIIG/703 because they can find their way through the menus by listening to differences in the menu beeps. Obviously, having the speech synthesizer announce the button presses would be really nice for them.

That's the end of my wish list. Not too major, but maybe enough to make a great transceiver even better.

Conclusion

I have to say that this is one incredible transceiver, and there is much more to it than I can cover in the review space available. The features, size, power, display, and overall capability are absolutely amazing. For a new ham starting out with no equipment, I think this would make a great first rig, which could then be relegated to permanent mobile or portable use when a full-size transceiver is purchased at a later date. Yes, it is pricey, but you get what you pay for. Years ago when I worked for Collins Radio, we had a saying that may be appropriate here: "Go first class and save!"

Is it time for me to upgrade from my IC-706MKIIG to the IC-7000? I'll answer this question with a second question: Is anyone interested in buying an IC-706MKIIG that is in great condition?

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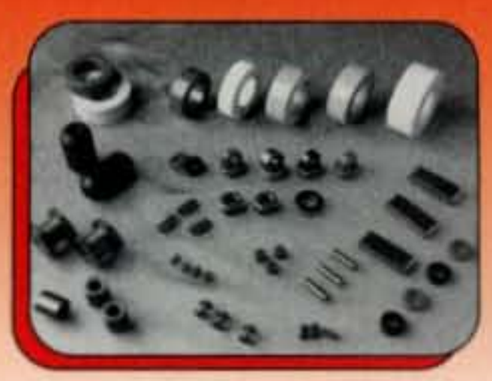
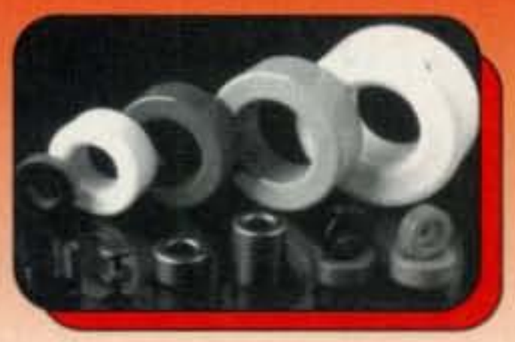

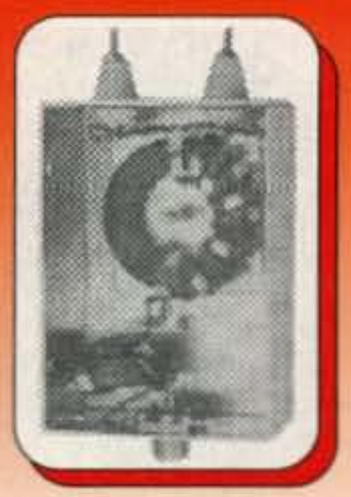

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